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AGENT-BASED SIMULATIONS BACKING USE OF ROLE-PLAYING GAMES AS DIALOGUE SUPPORT TOOLS: TEACHING FROM EXPERIMENTS.

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Role-playing games and computerized models are increasingly used to support negotiation processes with training, learning or policy making aims. They both have advantages and inconvenient. The joint use of both tools is supposed to improve the support. But no methodology exists to design and then analyze their combined used whereas they are assumed to influence negotiation processes. The aim of this article is, through the presentation of an experiment, to give some element to go further in the reflection of that issue.

Keywords: ComMod, Multi-agent system, role-playing game, Senegal, methodology

1 INTRODUCTION

Different experiments using role-playing games (RPG) and computerized models (CM) have been realized to support negotiation processes. Both are old simulation tools mainly employed with research or training aims. E.g. in research they are used in experimental economics to test behavioural patterns of agents (most frequently student) engaged in negotiation process and their similarity to game theory predictions (Friedman & Sunder, 1994). They are also used as training tools in various domains from military to educational exercises. Different types of games are used to reach these different goals. We focused on RPG as simulation games used in negotiation processes because they have already proven their relevance to stimulate and support coherent group change (Tsuchiya, 1998)

RPG is considered as the combination of three components: the game, the animator and the players. The game describes the world in which the party will be developed thanks to a system of specific rules. The animator knows all the rules of the game and help players to progress in the game. With his knowledge of the rules and players' interactions, he creates an

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enactment of reality. The players are the people taking part in the game. Each player makes his own role by following the rules (Mucchielli, 1983).

Even if, now, CM are known to be powerful to simulate artificial societies (see all the conferences organized with Agent-Based Models and artificial societies) and support negotiation processes (e.g., see all the literature on GDSS) they are communication tools which access is still difficult to users in interaction (Gardiner & Ritchie, 1999). RPG provide participants with simulation and enactment through their own participation in the game, whereas computer based models provide this through features in their interfaces. Some have used jointly these both ICT tools, the new one and the old one, in order to combine their advantages to better support negotiation processes.

In this article we quickly introduce different experiments using CM and RPG in order to present issues arising from. The second part describes our joint use of the multi-agent system Shadoc and the RPG Njoobaari ilnoowoo to insist on their synergy. In the last part, we come back to the issues to show how our experiment allows to go further in the reflection.

2 JOINT USE OF COMPUTERIZED MODELS AND ROLE-PLAYING GAMES: ISSUES ARISING FROM EXPERIMENTS

In a previous article published in the JASSS, O. Barreteau has presented a grid based on several experiments where Role-playing games and computerized models (CM) were jointly used in negotiation processes (Barreteau, 2003). The first part of our present article reminds the readers of its main results in order to set out the context of our experiment.

This previous paper was mainly based on several experiments presented in the thematic session called “Role-playing games, models and negotiation” of the Ecological Economic conference held at Sousse in 2002. Adopting a post-normal posture (Funtowicz & Ravetz, 1993), he shows that RPG are powerful as learning tool for players and/or organizers in training, research or policy making. Games are also used by researchers to grasp information on the social system studied (e.g., behavioral patterns for interaction), to test economical theories, or in psychological therapy. The main features of negotiation processes are interactive settling with more or less control and their own dynamic of time and space, complex systems dealing with uncertainty. CM or RPG used to support or learn from negotiation processes must consider their features and be in interaction with their users. For Barreteau each experiment draws a relationship between three poles {conceptual model, controlled experiment, observed reality} (Barreteau, 2003).

Considering that RPG and CM in association are usually based on conceptual model and used in tandem, the author proposed to analyze the experiments following two keys : parts of the shared conceptual model and concomitance of use (Barreteau, 2003). With the help of these two keys he presents all the uses of RPG and CM associated (table 1). In the first major category, all the experiments consist in a support in use from CM to RPG and/or vice versa (e.g., when the CM provides the spatial representation of the consequences of choices made by players - Meadows and Meadows, 1993). In the second main category, most of experiments expect mutual support in design and analysis from RPG and CM (e.g. when the model is used to better calibrate the game what can be useful to better understand the model - Duffy, 2001- or to limit boring repetition of gaming sessions – Piveteau, 1995).

	different underlying conceptual models	**same underlying conceptual model**
model and game are used within parallel processing	• model supports game enforcement • model included in the game • game as a communication mean between model and reality 1	• competition
model and game are used one after the other	• game to learn how to use model	• model to repeat the game • game to validate model • model to support game design • game to support model design • co-construction of model and game • model as benchmark 2

Table 1 : Classification of the categories of joint use of a computerized model and a RPG according to the sharing of conceptual model and the relative timing of use (Barreteau, 2003)

In reality, in most of the experiments presented, there is a co-construction of RPG and CM. And the reason of this conclusion is partly based on the artisan nature of these experiments. There is no theoretical methodology to design a RPG (Mauriras Bousquet M., 1984). It depends on the context, the public dealt with, the goal of the game, and many others elements. In fact, feelings and experiences are mostly at stake (Aquino (d') et al., 2002). The design of a game is an empirical approach to find the number of specific data and the type of association needed to create a scenario, a "realistic" simulacrum where players could evolve.

As a methodology to design RPG and the type of association with CM does not exit, there is also no methodology to analyse the influence of these tools on negotiation processes. At the present time, a lot of experiments have shown the power of the joint-use of RPG and CM to learn about social system, to grasp information, to support partly negotiation processes, to facilitate dialogue between negotiators by exchanging their viewpoints (Barreteau, 2003). We are at the "babbling point" of these experiments. And, up to now, nobody can say **what elements in his association between RPG and CM have influenced decision process or support dialogue or was helpful to reach the goals assigned by the experiment**. Because of the artisan nature of these experiments and the complexity of systems they dealt with, only an ex-post methodology could be built to analyze them and give some clues to our issues.

In the second part of this article, we describe one experiment of joint use of a RPG and a CM in order to bring some elements of reflection to this issue.

3 JOINT USE OF THE MAS SHADOC AND THE RPG NJOOBAARI ILNOOWO

In this experiment, we used the multi-agent system Shadoc and the RPG Njoobaari ilnoowo. They were both built in a companion modelling approach[4] (Bousquet et al., 2002) in Senegalese irrigated systems. The MAS was developed in order to tackle the issue of the viability of these systems confronted with economic, technical and social problems. Shadoc has been described in details by Barreteau and Bousquet (Barreteau & Bousquet, 2000, 2001). The RPG was created first, in order to open the black box of the agent-based model to validate the hypotheses implemented (Barreteau, Bousquet, & Attonaty, 2001) and second, to use these models as support tools in negotiation processes. To reach this second aim a lighter MAS was built (In this part we will call it Shadoc 2). Njoobaari ilnoowoo has been already described in details (Daré & Barreteau, 2003).

3.1 The Context Of The Joint-Use Of MAS And RPG: Preliminary Conditions To Its Introduction To Stakeholders

Conditions to use the RPG with stakeholders

Because gaming is not considered as serious, the use of Njoobaari ilnoowoo needed to be prepared carefully. The first condition was to analyse the cultural position of game in the society where it will be used. In the Senegal River Valley, people are Muslims. In the Koran, game is illicit, because it is linked with money games or considered as a potential diversion to pray (Qaradhawi, 1992). In the village of Wuro-Madiu, where villagers are profound believers, Njoobaari ilnoowoo was not introduced as a game but as a new type of working session, between work and theatre. Game sessions were presented as one step of a research process started with more classical interviews. Even if during the session stakeholders understood that it was a “simulation” (as some said), the first aversion to game was avoided and stakeholders really participate to the experiment.

Secondly, the conditions that could explain the involvement of each type of participants in the game was analyzed: i.e., reasons of choices of players, relationships between players, type of their compensation; how many animators, interest of observers’ points of view in the analysis, observers and animators’ profiles. The last condition was to have a reactive research process in order to answer to players’ criticisms. As an example, in the two first sessions, players have noticed that although they played during six hours, two cropping seasons were not enough to see the consequences of their collective decisions on the irrigated management system (financially and on an organizational level). So the MAS version of the RPG was introduced in the next sessions in order to speed up time.

Conditions to use the MAS to assist the RPG with stakeholders

[4] http://jasss.soc.surrey.ac.uk/6/2/1.html

First we decided to introduce Shadoc2 with stakeholders who had already played the game without the MAS in previous sessions. At the beginning of the session, players have drawn randomly playing cards (production goals, credit reimbursement, and status cards) that determine their roles. They organized into two groups: two villages and two farmers associations (economic interest groupings, EIG). They negotiated the position of their plot in the irrigated system painted on a board. All these data plus those coming from initial negotiations (water distribution rules, allocation of bank credits rules) have been registered in the computer with their control. The Shadoc2 interface allows the players to follow and verify the information registered in the program (cf. 3.2). Then some cropping seasons were simulated with this set of data.

After this step, a second stage with the cards and the players has started as soon as simulation parameters were supposed to indicate the potential occurrence of a critical situation. Different simulation indicators were followed in order to anticipate negotiation processes in the game:

- The level of the bank finances confronted with the credit allocation rules decided by the banker: if the funds are less than players' claim, we assume that money trade-offs between players would be necessary to pay the inputs of the played cropping season.
- The level of pumping station finances after the reimbursement of water fees and the water distribution rules settled: if its funds were less than 5000, only five turns are possible. Beyond, we supposed that players would have to negotiate to pay gas oil of the last turns.

3.2 Practical Links Between Shadoc And Njoobaari Ilnoowo

Before describing the joint-use of the RPG and the MAS, this chapter is to insist on the physical links between both tools.

Class	Number of instances in the MAS Shadoc	Number of instances in the RPG
PumpStation	1	1
Reach	1	1
Watercourse	5	2
Plot	$30 \leq Np \leq 100$	$10 \leq Np \leq 15$
Farmer	Np	Np
Group	$7 \leq Ng \leq 11$	2
(Social)Representation	Ng + Np	Ng + Np

Table 2 : Number of agents and objects

In the Table 2, the number of agents and objects in the game and in the first MAS are presented. The MAS Shadoc2 we used in our experiment was a simplified version of the MAS presented in this table. A simplification of the first MAS was necessary to use it to assist the game. To do this and keep the complexity of interactions between agents in the system represented, some rules were eliminated with the help of a local farmers' association and the season was divided into eight turns with a time given for negotiations during research of loans and cropping season assessment phases (Barreteau et al., 2001).

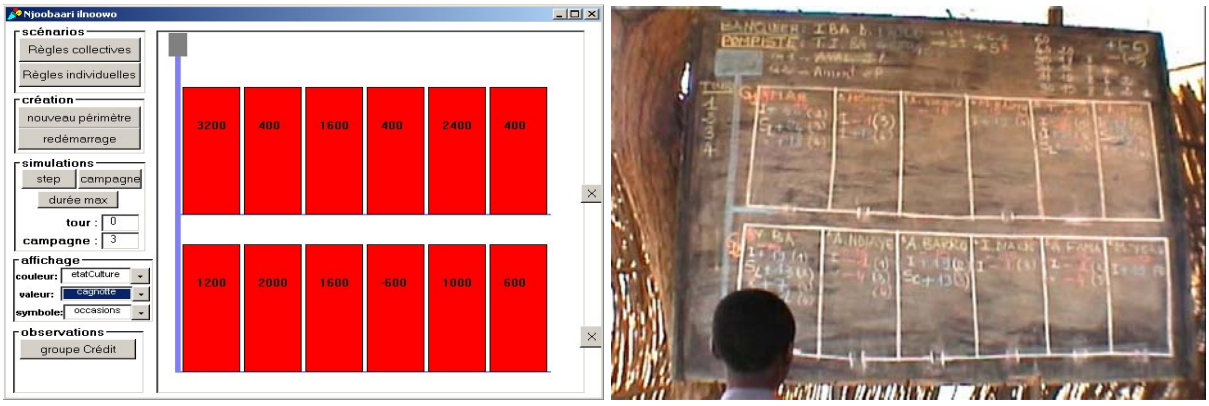


Figure 1: The irrigated scheme in the MAS and in the RPG

The figure 1 shows the interface of the irrigated scheme in the MAS Shadoc2 that represents the one drawn on the blackboard. Several type of information can be represented in the MAS: the plot colour is related to the growing stage of the crop sowed (figure 2), the number in each plot reveals the level of individual funds. At each turn the level of water entering in each plot and the opportunity card drawn at random can be presented (figure 2).

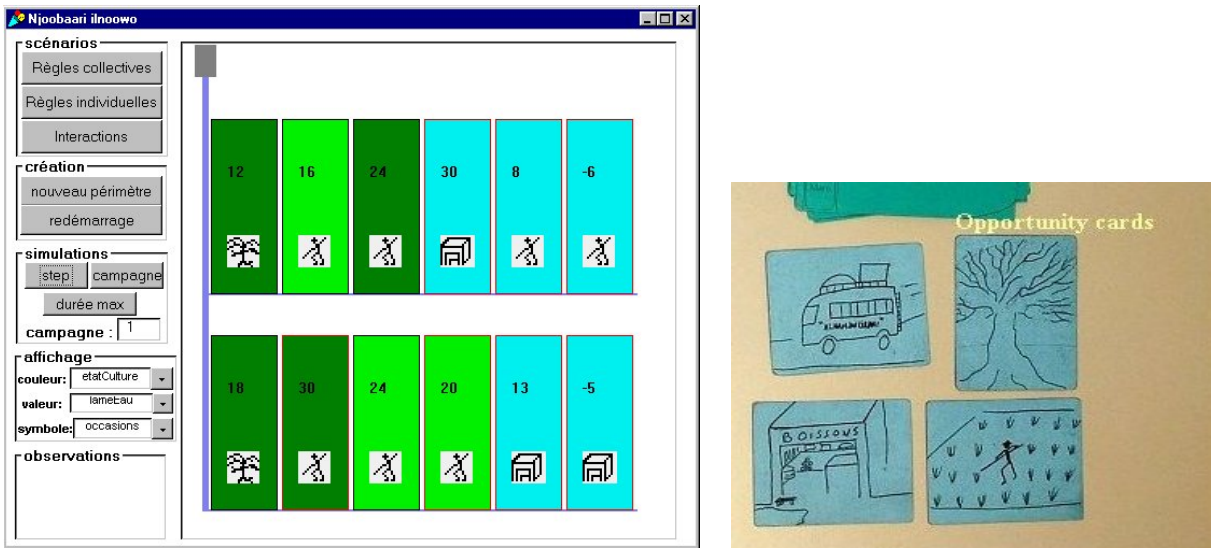


Figure 2 : Interface recalling the opportunity cards.

The interfaces presented show the efforts done to create practical links between the MAS and the RPG. Let us see now through an example how Njoobaari ilnoowoo and Shadoc2 have been jointly used.

3.3 Example Of The Joint Use Of Shadoc2 And Njoobaari Ilnoowo.

The session described here is the first realized in Wuro-Madiu village with a MAS and a RPG. Two had been organized before without the support of the computer. The first cropping season simulated was run step by step. Each result was justified. Because the parameters had not reach the critical points, a second season has been simulated but more quickly than the first one.

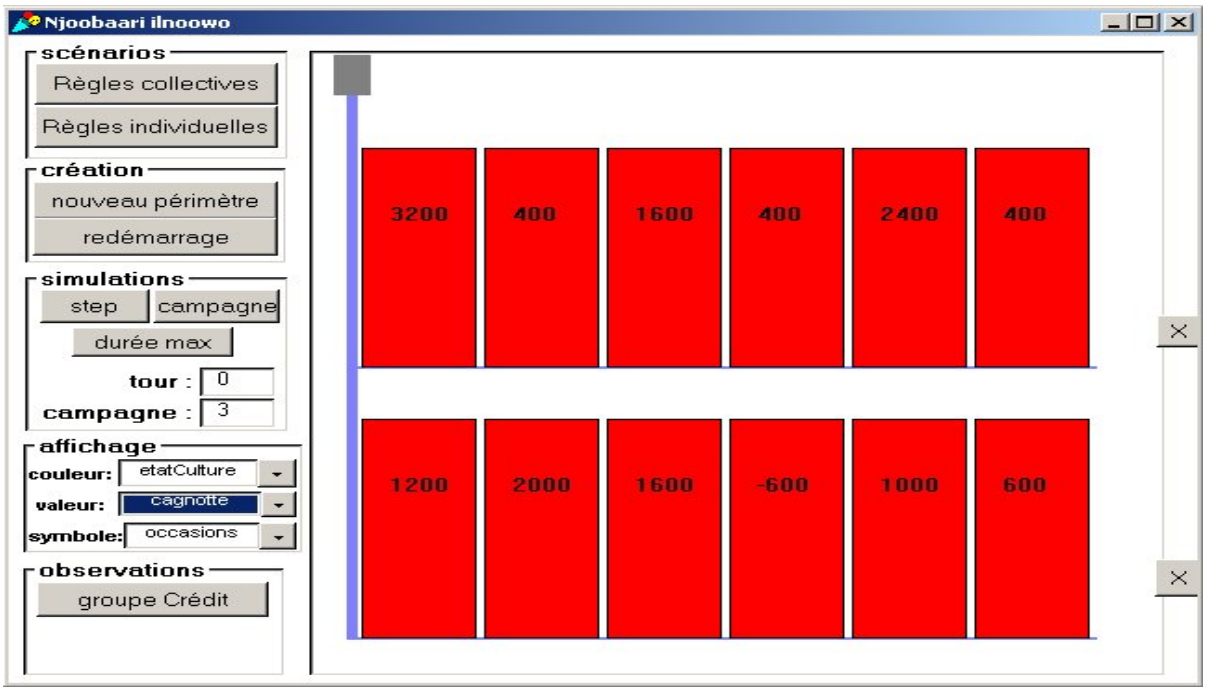
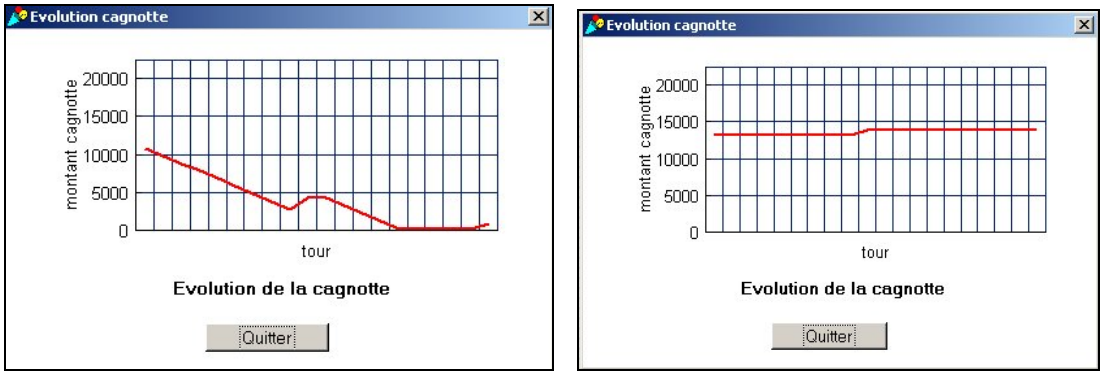


Figure 3 : Players' funds before starting the cropping season played

After the two cropping seasons simulated, animators have given to players their new level of individual funds (figure 3) and the information about the finances of the bank and the pumping station. The pumping station had no more money left. The funds of the bank were more or less 14000 (cf. figure 4).



pumping station bank

Figure 4 : Pumping station and bank funds before started the cropping season played.

By practising what H. Garfinkel call the *breaching* (Garfinkel, 1984), which consists in a destabilization of a routine to produce meaning, we assumed that some problems will appear during the next cropping season. In this case, the level of the pumping station was to low to be opened during the played cropping season. We thought that intense discussions would occur between players to find the money needed to pay the water fees or to negotiate new water distribution rules. So we decided to start the played cropping season to observe players' behaviours and interactions in such a future crisis situation.

The results of the simulation were accepted by players even if some of them felt injured. They understood the logic of the simulation but their main critic was that they do not behave as the program. For example, if they saw that a crop needs water, the owner of the plot may negotiate to exchange his turn with the farmer who has the right to irrigate at this moment. So the crop would not have a water stress. This event occurred in previous sessions. Despite everything, they accept to start the game with the elements given by the results of the simulation. After the end of the first turn, players asked for a break in order to find new credits. Spontaneously, players decided to give to their EIG (economic interest grouping) president the power to negotiate the trade-offs of money with the bank. He organized the collect of farmers' information about the inputs they needed to produce during the next cropping season. But because the Bank had not enough money left, farmers in each EIG decided to collect money between them: one richer lending money to others poorer. The president of each EIG was able to pay to the pumping station in order to have water in their watercourse during all the cropping season. Then, the irrigation/production phase could continue.

During this phase, all the members of the EIG have respected strictly the distribution rules they had chosen at the beginning of the session. The tables 3 and 4 present the actions realised by players during the game session. They show that because of the combination between "occasion cards" and "goal cards" some were not enough present on their plot to cultivate their rice. That is one of the reasons why the players P9 and P15 did not sow. These results illustrate also that the calculation of water flow in each plot is to strict. Water flows are too tiny to allow each player to sow in a cropping season. We already know this fact. But if these tools are used to support dialogue between stakeholders in irrigated scheme, we consider that RPG and MAS must reflect their troubles to make them think on potential solutions.

Watercourse n°	Name	Turn 1	Turn 2	Turn 3	Turn 4	Turn 5	Turn 6	Turn 7	Turn 8
1	P4	O						O	
1	P5	O	O				O		
1	P6		O	O			O	O	
1	P7			O	O				
1	P8				O			O	
1	P9					O			
2	P10	O						O	
2	P11	O	O				O		
2	P12		O	O			O		
2	P13			O	O				
2	P14				O	O		O	
2	P15					O			

Table 3 : Irrigation actions (« O » when a player Pn opens his pipe)

Watercourse n°	Name	Turn 1	Turn 2	Turn 3	Turn 4	Turn 5	Turn 6	Turn 7	Turn 8
1	P4		L			*	*		R
1	P5			L					R
1	P6				C				R
1	P7					C			R*
1	P8					C			R*
1	P9								
2	P10		C						R
2	P11			C					R
2	P12				C				R
2	P13					C			R*
2	P14					C			R*
2	P15								

Table 4 : Farm work realized (“L” or “C” indicates the variety sowed: long cultural cycle (L) or short one (C); “*” indicates the occurrence of a hydric stress; “R” is written when a plot is harvested)

4 Discussion

As a discussion, we come back to our main issue: what are the elements in the joint use of RPG and CM helpful to reach the goals assigned to the experiment? In our example, we focused on one use of both tools: support dialogue between stakeholders. What are the teachings given by this experiment?

First, to use these tools to facilitate dialogue between stakeholders on their real system, the simulacrum created with the RPG and the CM must be suitable to them, i.e., accepted as a representation of their reality. In this goal, the reasons of the results given by the simulations must be transparent, i.e., explained to players in order to make their logic clearly understandable. Otherwise, the unfairness feeling by some players at the end of the computerized simulation would break the legitimacy of the experiment and a discussion on real system would be difficult to initiate. With the help of the MAS, we were able to simulate two sessions and play the third one in about three hours. Even if players generally considered that Shadoc2 was not enough opened to change some rules during the simulation, they accepted the results of this first phase. Why did stakeholders legitimate the association of both tools to support dialogue on their reality? Maybe because they have already played with the game and the simulation revealed results they had already faced in the previous sessions. CM are not easy to be grasped by stakeholders not used to work with. In that case, sessions with only the RPG were very helpful to introduce the MAS. They were used as a sort of benchmark to explain the computerized simulations. Stakeholders feel better at ease when the joint-use is presented as an answer to their previous requests. A second element can be given by the capacity of this MAS to present step by step the evolution of the system. So players can see that there is no trick. A third reason may be that the representation of their system in the RPG was already accepted by them. They considered it as legitimate. And the MAS was introduced as a answer to their critics in the previous sessions. So because it was seen as a component of the game, it was, therefore, also legitimate. But the main reason should lie in our social status in the experiment. We were known to operate in a scientific way. We were legitimate to help them to think about their water management difficulties. So even if the

results of the simulations with the MAS were criticized, the most important was that they support dialogue on credits in the irrigated system which is actually their main difficulty.

Second, to initiate dialogue with these tools we develop “tense” situations of action in order to make them interact and express their viewpoints. The MAS was helpful to create such situations. In our different experiments with the RPG used alone, only two cropping seasons were played in half a day. And in these sessions, interactions between players were focused on water distribution. Tensions have appeared but they were specially linked with consequences of selfish behaviours in the access of water on the production of a whole EIG. With the support of the MAS, we were able in less time to reach the third cropping season where the reasons of the tensions were not the same. The joint-use was helpful to discuss on others difficulties. Thus, speed up time with the association of RPG and CM allows to go further in the dialogue process.

Third, the CM is supposed to simulate interactions between agents in a controlled experiment. We stopped the computerized simulations thinking that discussions in the following game would be focused on a particular point but they did not. In fact, as the players felt surrounded by the relative lack of flexibility of the computerized simulation, the game compared to the CM was seen as an opened tool. Even if rules and roles framed the game, degrees of freedom exist. They are necessary to make players evolved in the game. We tried to simulate a session of play (without the CM) by implementing the information occurred during the game. We could not reproduce the results of the game just because we had no information on the degrees of freedom, where, when and above all why they are used at an exact moment? Are they correlate one with another(s)? What we have shown in our experiment is that reality is invited in the game as in most game experiments (Daré, 2004; Daré & Barreteau, 2003; Duijn, Immers, Waaldijk, & Stoelhorst, 2002). We think that degrees of freedom are necessary to make them express their viewpoints and original interactions. These original interactions and opinions are often linked with reality. The methodology to analyze the influence of both tools on real systems must consider these elements revealing the introduction of reality in the game. To reach that goal, we insist particularly on the analysis of debriefing meetings with the players, in which the CM might be used as in Etienne’s experiments (Etienne, 2002).

In fact, RPG is altogether a strategy and a representation, is appealed to cooperation and conflict between players. It swings between the reality of interactions and the fiction of the simulacrum. It is a sort of pure integration which help players to be aware of reality (Piveteau, 1995). Even if a set of rules gives a framework to players’ behaviours, their interactions influence the progress of the game and, thus, create complexity. Sessions of a RPG even with same players are never the same.

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